

Public Forum on Safety, Mobility, and Aging Drivers

In November 2010, the Safety Board convened a public forum of twenty experts and a dozen interested organizations to explore the safety issues related to aging drivers and to discuss possible strategies to prevent and reduce accidents, injuries and fatalities within this growing population. The agenda, presentation and participant biographies are on the NTSB Event Web site along with the full 2-day transcript. This summary, taken directly from the transcript, captures selected quotes from the forum participants that encapsulate important facts and concepts discussed at that public meeting.

Chairman Debbie A. P. Hersman, Chairman, NTSB

America is aging. Baby boomers are now well into their middle years. People, on average, are living well into their 70's compared to their 40's just a century ago. And more and more 'seniors' are on the road than ever before. In fact, thirty million licensed drivers in the U.S. are 65 or older, and the forecast is that by 2025, this age group will comprise more than 20 percent of the entire U.S. driving population – that's 1 in 5 drivers.

There's no precise way to define the term "aging driver." Just as no two 17-year-olds have the same set of driving skills, capabilities and experience; neither do two 70-year-olds, two 80-year-olds, or two 90-year-olds. Driver performance varies widely in every age group, and age alone is not a good predictor of how well one will perform behind the wheel.

Older drivers tend to be conscientious and safety-oriented – they wear their seatbelts, they may choose to forego driving when it's dark or when the weather is poor, they are less likely to speed or drive intoxicated, and they drive fewer miles than other age groups. The good news is that the number of drivers age 70 and older involved in fatal crashes has decreased in the past decade– by 20% -- even though the number of licensed drivers in this age group and the miles logged increased. Despite these encouraging numbers, we also know that, when there is an accident, it is the older driver who is more likely to be killed or seriously injured. They simply don't fare as well as younger drivers.

Panel 1: Safety Data Assessment of Transportation Risk and Aging

Anne McCartt, PhD, Insurance Institute for Highway Safety

The crash rate per mile traveled begins to increase at about age 70. This is true for fatal crashes and for crashes of all severity.

Older drivers do less harm to other road users compared especially to teens and people in their 20s. They are mostly a danger to themselves and to their passengers, who also tend to be older.

When we look at older drivers you see dramatic increases in the percentage of people holding onto their licenses, especially the oldest drivers, 80 and older. So when you put these things together, what we

expected to see when we look at crash deaths of older people was an increase, but in fact we've seen just the opposite. If we go back to 1975 and we look at crash deaths of older people, after a steady upward trend, what we found, they peaked in 1997 and then they've been coming down and coming down very strongly.

We know that self-assessment of driving competency is pretty inaccurate in at-risk populations. We know that older people overestimate their driving competency; everybody's better than average.

Taking a preliminary look at the latest National Household Travel Survey, older drivers are driving more in the aggregate and also on average, and we know for drivers of any age, drivers who don't drive a lot of miles have higher crash rates.

There are some really important limitations in trying to take a look at why older driver crashes are down. We don't have, as I said, a good national sample of nonfatal crashes that would allow us to look in detail at the crashes of older drivers. We don't have perfect licensure data. And we know that they may be particularly problematic for older drivers if a state has a long renewal period. It may be that the numbers overestimate how many older drivers are licensed; people who are holding on to their licenses because we use licenses for all sorts of purposes, at the bank and in airports.

Sandra Rosenbloom, PhD, University of Arizona

Increasingly, older people live in low-density and suburban areas. About 75 percent of older people either live in suburban or rural areas nationally.

Women are substantially more likely, women over 65, to live alone, so that they have no other driver in the house when they start to have problems. They're significantly less likely to have financial resources to allow them to purchase services or alternatives, have goods delivered to them when they no longer feel safe in driving. We know that older women generally cease driving much before older men, because they don't feel comfortable. It's often not some kind of medical reason or because they've had a crash but because they don't feel confident. Even among the very youngest women, they're still driving only 8 miles for every 10 miles driven by men and these older women are driving three and four miles for every mile driven by a comparable man.

There is a tremendous tension between mobility and safety. It's one thing to make three right turns instead of making a left turn. That doesn't really have a lot of impact on your life. It's quite another to avoid all congested areas, to avoid driving in the morning peak, the noon peak or the evening peak. It's quite another to avoid certain routes and stay off of the freeways and highways.

You cannot address safety issues independent from how people live their lives and where they're living, and we have to deal with them both. Mobility and safety are two sides of the same coin and often we are forcing older people to choose between them and that's not acceptable.

Older people are substantially less likely to move than younger people. Most people stay in the home where they were when they were still in the labor force. Stories about older folks moving to the downtown of an area, you see those in the papers sometimes, those are what we call man bites dog stories. They're reported on because they're unusual. In fact, older people that do move are going the other way.

The Americans with Disabilities Act requires public transit operators to provide at least curb-to-curb services. The percentages of the total system ridership for all the services are very small; the highest is Miami at 2.4 percent. So if you take Mrs. Jones to the doctor in Boston that costs you \$33.21. If you take her to the doctor and bring her home, it's \$66.42. And, in fact, the number for the largest 50 systems in the country is about \$37 a one-way trip. Which explains the percentage of total system costs these ADA services require; Miami is spending almost one out of every four transit dollars to provide these ADA services to a very small percentage of its total ridership. These systems are not very likely to expand.

What I'm seeing among adult children of older drivers in the United States is yes, they're worried, but they're equally worried about what is it going to mean to them when their mother stops driving? And it's not just the driving. It's will she come live with us? Will we have to move her to a care facility?

I do think that there are public transit options that are more geared to older people, but I think the answer really is to use the underutilized capacity in cars, all those empty seats in cars. And I'm a very big advocate of volunteer driver programs, which are much less expensive than these kinds of things and are a way to provide services in the low-density areas where public transit and these kinds of services are not going to make sense.

Bonnie Dobbs, PhD, University of Alberta

Changes associated with normal aging are unlikely to affect a person's ability to drive, but illness plays a critical role and that's particularly important for the older driver population because of the age association of many illnesses, such as dementia. Because of the prevalence of medical conditions, it seems to me that we need broad involvement, and that includes involvement of the medical community, the law enforcement community, the individual, families and friends, the community at large, and certainly licensing authorities.

We need the medical community talking or working collaboratively with the licensing community. We need individuals' families coordinating or talking with the medical community. We need to develop a more coordinated system.

If you look at mobility in the community, we tend to think of mobility in terms of public transportation, buses, LRTs, and taxis. Unfortunately, for the medically impaired driver and often for the frail older driver, those forms of transportation are simply unacceptable.

People often think of the senior population as being a homogeneous population, in fact, there's more heterogeneity in the senior population than in any other age group.

Older females often engage in premature driving cessation. We can likely do some interventions to have them continue -- to give them training and increase their perceptions of competency -- and keep them mobile.

Men outlive their driving careers by 6 years and females outlive their driving careers by 10 years, based on the research from Foley and colleagues.

The issue of restricted licensing is interesting, most often it's predicated on the recognition that mobility is so central to our independence, and restrictions in driving are appropriate, I would argue, for some segments of the older driver population. For example, individuals with visual impairments, restricting their driving to daytime-only makes sense. But often those restrictions are generalized or extended to individuals with cognitive impairment, and in those instances it's inappropriate. My analogy would be that we wouldn't think about letting an alcohol-impaired driver drive within a five-kilometer radius of home. We wouldn't restrict an alcohol-impaired driver to driving between 10:00 and 2:00 in the afternoon. That's essentially what we're doing with an individual with a cognitive impairment who's no longer safe to drive.

In Canada, in all provinces, with the exception of one, having a driver assessment is user pay. The Province of British Columbia now is paying for a driver assessment for medical reasons.

In the primary care setting, two-thirds of all dementias are missed and 90 percent of mild cognitive impairment (are missed). So the driving (assessment) really does need to be on the radar screen.

While there is a segment of the baby boomer population that is going to be healthier than their parents, there also are going to be segments of the baby boomer population that are in poorer health. Diabetes is at the epidemic proportions. Cardiovascular disease is at epidemic proportions. Right now in the United States one in seven Americans has dementia. So, 3.4 million Americans 71 and older have dementia and that's projected to increase sevenfold with the aging of the baby boomer population.

Ann Dellinger, PhD, MPH, Centers for Disease Control

Older drivers tend to have higher crash rates when you take into consideration how much they drive. So is this because they truly have more crashes or is this because they're more likely to be hurt or killed in a crash? The answer is critical because if you're causing more than your share of crashes, maybe the safety measure that we need is to take you off the road. In short, you're responsible. But if the answer is that you're just more likely to be hurt, the safety answer might be to improve vehicle safety features or roadway safety features. In short, you're physically frail, you're not responsible.

So when you take into consideration frailty and fragility, a low-mileage bias, and maybe the types of roads that older drivers are driving on, it makes a difference in your consideration of how much of the excess crash involvement is the responsibility of the drivers themselves or not.

How much do you drive? Drivers who drive a lot tend to have fewer crashes and drivers who drive fewer miles tend to have more crashes. So is this because they've self-restricted to slower speed urban roads where they're more likely to have potential conflicts and crashes, or is it because of a reduced driving ability, so they're driving the minimum that they need to get by?

Factors affecting whether your physical frailty will lead to injury or death in a crash include whether you were buckled up, how safe your vehicle was, and what kind of medical care you received.

The contribution of frailty to excess crash involvement is interesting to quantify and, in fact, the proportion has been estimated at 60 to 95 percent of the excess crash involvement.

A recent study from CDC shows that the annual average cost of traffic accidents are about \$500 per licensed driver. We added medical costs, medical spending and productivity losses; what did you lose because you couldn't work? We're less concerned, say, with property damage costs, travel delays. We're more about injury prevention. So it's a very conservative cost estimate of motor vehicle crashes in the U.S. This human capital approach (the work productivity component) undervalues children, women and the elderly. The \$118 per capita for older male drivers was an average, and for older women it was \$67.

We've used 65 and 70 as the most common ages to talk about older drivers. I think 65 because that's when, traditionally, Social Security started. I don't think there's any biologic or physiological reason that we decided to use 65 and above. We can use 70 and above. I think that those U-shaped curves for crash involvement make a case for 70 and above. You can probably also make a case for 75 and above. But there's no right answer to that.

Panel 2 - Occupant Protection for Aging Drivers and Passengers

Stewart Wang, M.D, PhD, University of Michigan

Elderly individuals are more fragile in that they sustain more severe injuries. Given a specific mechanical load, they break more easily. This is different from the fact that the elderly individuals are also frailer, in that they experience a worse outcome given a certain injury. What's important is that there is substantial variability between individuals.

It's very important to touch on the fact that they don't break more easily in every single specific location. So if you look at the NASS data -- 10 years, just for belted drivers and frontal crashes at 30 miles per hour -- look specifically at thoracic injuries, what you see is that rib fractures are very, very frequently observed in the most elderly population.

I'd like to relay a common story that we see all the time in the surgical ICU. There's been a motor vehicle crash, a patient comes in with chest injuries and in the elderly, and these almost always involve rib fractures. And because of these rib fractures, it causes a lot of pain. These elderly patients typically have decreased pulmonary reserve. They end up on the ventilator for support. Once they're on the ventilator, you have difficulty clearing secretions and we know that the longer they're on the ventilator, the more likely they are to get pneumonia.

What we have found is that body condition in the specific core muscle mass predicts survival after surgery. People that have the smallest amount of core muscle experience the highest level of mortality. We've studied this in aortic surgeries, in liver transplant surgeries, and multiple surgeries, and what we've found that the psoas muscle is by far the best predictor, far better than age or comorbidities.

So from a trauma surgeon's perspective, they come to me after having sustained their injury and what we have found is that what really matters is the body condition and not the age.

Just think about the issue of obesity. The size of the patient population, the individuals, has changed substantially. And while crash dummies are very nice and they represent a standardized segment of the population, my personal opinion is that this is going to become a problem as the population becomes even more fragile and frail and there is even more patient variability.

So in summary, age is a very poor descriptor of condition, as are preexisting medical conditions or comorbidities. Body characteristics are much better indicators of fragility as well as frailty. My assessment is that current crash injury databases collect no specific or objective data regarding occupant characteristics. Even the best provide, if possible, age, height, weight, and just a number of comorbidities, none of which are sufficient.

Richard Kent, PhD, University of Virginia

If you look at the injuries that older folks die of in the hospital, they will frequently die of injuries that are no more severe than the rib fractures. So it's not massive cardiac lacerations or things like that that are killing folks. It is rib fractures and sequelae that develop from them.

There are some things that generally trend with aging that have pretty important consequences for crash protection. A critical one is the change in the distribution of injury pattern: head injuries decreasing as age increases, whereas thoracic injuries make up a larger proportion as age increases.

About 30 percent of people over 75 who die in a car crashes die a day or more after that crash, whereas it's only about 10 percent in the middle-age group (age 30 to 45) and it's very low in teens. One of the things that I think is very illustrative, if you go to driver gender distribution by age in FARS in the age 65 plus, you see 45 percent male, 40 percent female, (and) fifteen percent are coded as either unknown or pregnant females. So probably not many of them are pregnant females, so what that means is 15 percent don't even have the gender coded. This reflects the fact that investigations of elderly driver fatalities are not done very thoroughly because it's not apparent they're going to die. In fact, I found

cases where the police report had been denoted no injury or minor injury, which had later been whited-out and fatal had been checked.

We can look at things like material property changes in the human body, things like osteoporosis, which are correlated strongly with age. The porosity in the bone decreases with aging. Also, the percent of the bone that is the inorganic compound, so the mineral, goes down with aging. Those are separate and distinct characteristics. Both change with age and both tend to reduce what we call the fracture toughness of bone.

The bone's cortical shell, the heavy, dense, really load-bearing part of the bone which is the outer shell, decreases in thickness from young to old. This is a significant trend. It's been observed in lots of populations. The bone essentially eats itself away from the inside and so you end up with bones that have similar outside geometry, but the cortical shell thins with aging.

With regard to CT scan of a ribcage from a 17-year-old (compared to) the ribcage from a 64-year-old, you can see a pretty dramatic change in the shape of the ribcages and we have found that the ribs tend to get more horizontal or perpendicular to the spine as one ages. And you can see this probably anecdotally. It manifests itself in sort of a barrel-chested appearance as we get older.

The biomechanics of aging are a challenging problem, but I think they're key to the idea of passive safety for older drivers. We did a study where we estimated that the aging of America over the last decade generated about half as many serious injuries as increased seatbelt use prevented. I think understanding the biomechanics is a key part of the solution and incorporating it into things like federal standards and safety countermeasures is important.

Stephen Ridella, NHTSA

NHTSA's older occupant research has two goals, which would be to eliminate crashes due to aging and to reduce transportation-related fatalities and injuries due to aging. A fourfold process could entail understanding the problem by data, older occupant safety, older occupant protection, and pedestrian safety.

The Crash Injury Research and Engineering Network that is part of NHTSA's data collection and analysis can inform us more of injury causations and mechanisms.

What's necessary are specific injury analyses for older occupants with respect to both gender and body mass, preexisting medical conditions and comorbidities, and also in-depth causation and mechanisms with respect to crash direction and crash severity.

Regardless, the analysis does show that age affects severe injury outcome for almost every body region in every crash mode.

Looking at the risk of chest and head injuries in a specific population, when you control for gender, belt use, the driver BMI -- in the passenger car in a side impact, the thoracic and head injuries dominate as age goes up. In fact, it's almost a fivefold increase in risk for a serious injury of the thorax and at least a twofold increase in risk of serious head injury, in the older population, everything else being equal.

(In) the Crash Injury Research and Engineering Network, looking at injury causation, we have over 300 cases of older occupant injuries with in-depth analysis and we'll be publishing extensively off of this work in the future.

One thing that's apparent, the use of computer models must increase, and computer models of the older occupants, human occupants, is, we think, a frontier that needs to be explored to evaluate restraint systems and vehicle designs of the future. With respect to that, we're doing work where we're characterizing age and gender changes in ribcage ages across all ages. From the youngest to the oldest, we're collecting CT scans to develop parametric ribcage models using inputs such as age, gender, and the size of the occupants, and then changing the shape, the mesh size, the density of the bone, and other mechanical properties to create a model that can then be used in a variety of restraint and vehicle conditions.

Similarly, for head injury research, we're characterizing age and gender changes to the head and brain. We're taking CT scans of a variety of occupants, from the youngest to the oldest, and developing a parametric head computer model. Inputs such as age and gender and other information that we get from the CT scans will go into a brain model, where we'll change the shape, size, and mesh density, thickness of the bone, the thickness and changes that we see in the morphology of the brain, and input that into what we have published recently, a brain injury model, to help us predict brain injury in older occupants as well as younger occupants and see what the differences might be as a result of input.

So in summary, we have identified an approach for older occupant injury research. We want to understand injuries and the causation as a critical path to future development of projects aimed at the most frequent injuries, brain and chest injuries. This will again help us to determine what dummies we need to use, models, test procedures that address reducing the incidence and severity of injuries for older occupants.

Stephen Rouhana, PhD, Ford Motor Company

By the time you're in the age category of 36 to 65, you have half the ability to withstand belt-loading on your chest. And by the time you're over 65, you have one-quarter of the ability to withstand belt-loading.

If you're 20 years old and you're in a crash in which a Hybrid III dummy would get 60 millimeters of chest deflection, you would have a 25-percent risk of injury and when you're a 70-year-old, you would have about a 90-percent risk of chest injury in the same crash with the same chest deflection.

We wondered, is there a way to reduce the chest injury risk for older occupants? And we answered that with, maybe with an inflatable belt-- a tubular airbag sandwiched between two pieces of shoulder belt webbing. In the event of a crash the airbag inflates across the chest within 10 to 20 milliseconds. (Inflatable belts) expand the area of the belt on the chest by five to seven times, which reduces the pressure on the chest to one-fifth or one-seventh of what it would be normally, and that reduces the likelihood of injury. This system is going into production in the 2011 model year Ford Explorer, which should be out in the first quarter of next year. We feel it will have great ability to protect older occupants by reducing their likelihood of chest injury.

Before we had airbags, we just had belts and we broke a lot of chests. The risk from belts alone is, especially for elderly occupants, is quite high. With the advent of airbags, we now have the ability to change the amount of load going through the belt. We could reduce the amount of force by having the airbag come out and take some of the forces of the restraint. So airbags do work in conjunction with the seatbelt to reduce the risk. More importantly, I think they reduce the risk of head and neck injury, but they are positive forces in chest injury protection.

Panels 3 - Highway and Vehicle Design Elements

Dick Schaffer, FHWA

The 1998 older driver handbook was updated to the 2000 Highway Design Handbook for Older Drivers and Pedestrians. Since 2001, we have an older driver training course taught by our resource center in which we take this around the country to really show traffic engineers and traffic specialists why this is important and how to use it. We're looking at updating this in 2011 to incorporate new research and the 2009 MUTCD.

The Manual on Uniform Traffic Control Devices has led to safety improvements and, less crashes and collisions both among drivers and pedestrians.

Another thing that can help the pedestrian and has worked quite well is reducing the right turn radii. It reduces the speed in which you can take that particular right turn, and at the same time helps the older pedestrian because there's less crossing distance. We can also look at a pedestrian island, for example, where they can use that actually as a refuge island for safety purposes.

Joe Coughlin, PhD, MIT Age LAB

I'd like to discuss the convergence of new technology and older age and have us think about some design considerations that we may want in the future of the car.

The new lead adapter of (automobile) new technology is not the young, but those of us who are older. But the problem is we no longer have a mental model of how these new technologies work in a car and how it changes how we drive. We have new systems that are going to require us to relearn how to drive.

Technology adoption does increase, believe it or not, with older adults. It gives them greater confidence. Our work with The Hartford shows, with survey data nationwide, that older adults, if it is related to safety, will use technology. They're also more likely to self-regulate using the technologies that are likely to distract.

The fact is, birthdays do not kill; health conditions do. As we live longer, we will have greater comorbidity. 110 million Americans already, regardless of age, have one chronic disease; 60 million with two.

We envision a car that will help coach and monitor overall well-being for the driver and change its performance in real time to match the driver and have cues to actually say that you're running out of your performance range or you should be improving your overall performance behind the wheel.

We need to conduct research on how we understand and adopt technology across the lifespan. This has not been done in the auto area, let alone in many other areas. More importantly, we need to develop quantifiable guidelines to mitigate the impact and interactions of design, workload, and age on driver performance.

The way we buy our car today is no different than, frankly, our parents and grandparents: We take the car; we're excited; the dealer's excited; here's the air conditioning; here's the entertainment system; here's how you adjust the seats and here are the keys. We need to do more of what we see in Europe and some other places where the delivery experience is an education experience that gets you familiar with the new technology, of what to expect and how to drive.

With the aging of the population, with far more women on the road, we now need to engineer not just to the reasonable man standard who happens to be 5'10", 25 years old, and 165 pounds, but to a reasonable older, smaller woman standard and what that means in terms of design, as well as technology.

Thomas Broberg, Volvo

We're all different as human beings. There are 5 billion variants of us out there. And when we design technology in our vehicles, we really have to understand the differences between us, or if there are any differences in our behavior when we drive our motor vehicles. So this is really the challenge, as we see, when we move to the future.

What is causing accidents? There are a few big ones, distraction being one, of course; alcohol involvement; drivers falling asleep. And of course, we're addressing this with technologies that are in the cars today.

We have already launched technologies that help drivers avoid collisions in certain circumstances, crashing into pedestrians and so forth. We have dynamic systems that help drivers if they're in a critical situation, like if the car is sliding and you have dynamic stability and traction control to help you stay on the road. But we're also looking into how we can assist drivers to be in a good state, both from a distraction point of view with actually trying to reduce the workload from the car for the drivers with, for instance, our Intelligent Driver Information system; likewise, the driver alert control addressing drowsy drivers or inattentive drivers. So the car can actually recognize how the driver's actually performing with the vehicle.

We're starting to give a car senses. Today the cars can see and they can also feel. They can feel what the driver's doing or actually what the driver's not doing. And in certain situations, where it's appropriate, the car can actually help the driver avoid collision autonomously. The knowledge of driver behavior and how drivers adapt to technologies is a key enabler for us as we move forward.

We are involved in a research project in Europe called SARTRE, which is actually looking into self-driving cars more from a platooning perspective to where the driver can actually connect to a road train so that you can do your ordinary business, typically on your way to work.

David Eby, PhD, UMTRI

The presence and use of advanced technology in vehicles is increasing. This includes technology that is original manufactured technology, technology that's built into cars but also ematic technologies--cell phones and smartphones can do all sorts of things and people bring those into cars to help them drive, such as navigation systems, and all of these technologies are going to be much more common in the future. Advanced technologies have the potential to increase the safety of older people, as well as their quality of life.

Route guidance systems provide turn-by-turn instructions to people as they drive. They use GPS signals to locate vehicles and the design features can vary widely, including voice controls to let people know, without having to look at the displays, what the next maneuver is. There's also night vision enhancement systems that use infrared technology that can detect warm bodies (animals, pedestrians) out in the roadway, especially under limited view conditions like fog or nighttime.

There's a whole set of crash warning systems. There are forward collision warning systems, lane departure warning systems, curve speed warning systems. These are all systems designed to help a person prevent getting into a crash. They use various kinds of sensors and radars to let you know where traffic is in front of you, sensors that can pick up where lane markings are so that it can determine what position in the lane you have, and then provide warnings. In some cases these warnings can be as simple as an auditory alert; they can be a haptic alert where there's a shaking; or in more advanced systems there can also be some control of the vehicle like braking that takes place without the driver having to do anything. Finally, there are automatic crash notification systems. These are systems that, in the

event of a crash, information is sent directly to an emergency responding system, and that information can be fairly sophisticated including some of the dynamics that are recorded in a crash.

Our research findings, as well as findings of others, show that older people like these advanced technologies. Older drivers also use these technologies as much as drivers of other ages. In the case of navigation systems, our research shows that they're used even more than with the younger populations. Older drivers report that many of these technologies actually make them feel more confident while driving and less stressed while driving, which helps them be comfortable going to places and other destinations. It increases their driving space.

Older drivers do report difficulty understanding symbols and the warnings more so than for younger people, and so I think we still have some work to do on developing symbols and warnings. Older drivers report more difficulty using these systems, especially the systems that require some sort of input.

Older drivers have also told us they would not purchase technology that's labeled for older people.

Technology should recognize and accommodate how older drivers drive and self-regulate. For example, in our studies with navigation systems, we found that some older people wanted to co-navigate. They had a spouse that was in the passenger seat, the spouse operated the device and the device we were using, the device could not be manipulated when the vehicle was in motion and that bothered the co-drivers.

Older drivers take longer to learn how to operate advanced technologies. However, once they do learn how to use the technologies, they can use them just as well and understand them just as well as younger people.

Our University Transportation Center, M-CASTL, is working on a project right now with Paul Green to develop a routing that would be more appropriate for the kinds of self-regulation that an older person might do based on some sort of medical condition.

Panel 4 - Enhancing Driving Performance

Lisa Molnar, MHSA, UMTRI

Driving is a complex task that requires visual, cognitive and motor abilities, and as we age, most people experience some loss in these abilities due to medical conditions that become more prevalent with aging and also, the medications used to treat them. We know that this process has a lot of variability from individual to individual. The issue of evaluating driver fitness, which is what we really want to talk about today, is really complex and it's often controversial for a number of reasons. First, there's a lack of clarity about the difference between screening and assessment.

Screening and assessment really represent different and distinct domains of driver evaluation. Screening is really the first step in a multi-tiered process. It's not something that, in and of itself, should be used for making licensing decisions.

Screening is used to identify very obvious impairments in functional abilities—vision, cognition, and psychomotor skills. It's intended to lead to more in-depth evaluation if gross impairments are identified, but it should not be used to make final licensing decisions. Screening involves a number of players from the community. It's done in licensing agencies. It's done in physician offices and other clinical settings, by occupational therapists. It's something that can be done by law enforcement who are making traffic stops of older drivers. It's something that's also done in the community, by friends and family members of older drivers who might be experiencing problems and it's done by older drivers themselves.

Screening offers an opportunity to intervene early to identify red flags and if necessary, refer patients on for more in-depth assessment. Some of the work that's been done in the physician area has included developing guides for physicians like the AMA Guide for Assessing and Counseling Older Drivers that offers information about the kinds of red flags that might alert a physician to something that might be problematic with driving. The physicians' guide also contains a screening battery called the ADReS, which has a series of tests that can be administered. Similarly, in the licensing area, there's been a lot of work on developing some protocols for doing observations at the counter, as well as developing batteries that look at the kinds of limitations in physical functioning that we know are associated with problems with driving.

One early work that came out on screening tools for licensing agencies, the MaryPODS study, identified a number of functional abilities that are associated with crash risk and it also identified a battery that had a number of tests for those abilities.

To date, there are really no tools that have been developed that satisfy all of these components (valid, reliable, low cost and easily administered). Screening tools really need to focus on looking at the functional declines in vision, cognition and psychomotor skills as opposed to focusing on age, per se, or even looking at the complex array of medical conditions that people might be experiencing.

Assessment provides a basis for identifying reasons for functional deficits, determining the extent of driving impairment and making recommendations about licensing actions, also, identifying options for driving compensation or remediation.

Richard Marottoli, MD, MPH, Yale University

In terms of what to assess, I would argue that actually, there is a benefit to looking at diseases and conditions in addition to functional abilities and impairments, in part because we're looking also for interventions and we're looking for things that we can improve. Functional impairments that result either from the disease or from the aging process alone are avenues for both assessment and intervention.

A variety of different global measures that can potentially be used by clinicians (include) things like information processing speed, attention in a variety of forms, visual spatial ability and executive function, and then physical ability--particularly range of motion and speed of movement.

Regarding the question of polypharmacy, there are many different categories of medications that can have both beneficial and potentially negative effects on either the conditions that they're being used to treat, but also on abilities relevant to the driving task.

Ultimately, the goal of gathering (driver) information is to convince the clinician of the need for change and then, ultimately, to convince the patient or driver and the family that indeed change is necessary and what that change should be.

One area that tends not to get looked at a lot, but is relevant to everything is issue of awareness or insight into deficits. (When) trying to have people change or modify their behavior, their awareness or insight into their deficits is critical in recognizing the need for change. Oftentimes, particularly for cognitively impaired patients, it's the family that ends up having to actually do the dirty work in terms of making that transition. So it's helpful to have them on board with that.

There is increasing evidence for the effectiveness of a number of interventions, particularly relating to those functional abilities, which, hopefully, will allow us to change the tenor of the discussion from one that's very negative to something that's slightly more positive in the process. There are also a variety of education interventions that can work more broadly rather than focusing on specific individual functional abilities, but take the actual driving task and look at that in more detail.

It tends not to be a two-way street in most areas, so we're asking clinicians to provide that information (on driver limitations) to a licensing agency, but very often there's no information that comes back unless there's an irate patient or family that then comes back and is very angry. But the clinician is often clueless as to what actually happened or transpired.

We tend to hear very little or know very little, in fact, about appropriate (driving) cessation and premature cessation. And I suspect that it does occur a lot, but there are a number of studies of cognitively impaired populations, suggesting that by the time they reach a dementia assessment center or a geriatric assessment center, most people have already stopped driving.

Arthur Kramer, PhD, University of Illinois

Most cognitive training programs are still in the experimental stage. Think of it as a Phase II drug trial, I suppose, if we want to apply it to drugs. But there are an increasing number of commercial products that purport to improve driver training. In fact, some of them even advertise that if you go through this training program, you can reduce accident rates by 50 percent. And I think it's worth evaluating them with the same level of scrutiny that we evaluate drugs in drug trials because I think they can have same benefit and/or harm depending upon the assessment.

There are some interesting and potentially promising results from these cognitive training programs. But if I evaluate them by virtue of the same information that is used in National Institute of Health consensus statements to evaluate research in a particular field, and I did participate in one of these within the last year on Alzheimer's and aging, I would say at present, given the present state of refereed journal articles, the evidence is weak at best.

When we look at those randomized control studies, there aren't many, number one. They tend to be underpowered quite substantially, number two. Number three, the effect sizes tend to be rather small. And what I mean by that is small in a statistical sense in terms of effect size, but also small in terms of the number of variables that are relevant to driving that show beneficial effects from various cognitive training programs.

I'm not suggesting that cognitive training programs aren't efficacious. I'm suggesting we need to collect the kind of data that we collect for drug trials and other kinds of trials; that is, set the same high bar and standard for these trials.

I think it's also the case that we, as scientists, haven't been creative enough in terms of the kinds of cognitive training programs we've pursued. As we've already heard from other speakers, this is really a multivariate problem. It's not a uni-variate problem in which it's just one aspect of cognition, or one aspect of perception, or physical function, or disease, or polypharmacy. In terms of cognitive training, we don't focus on the richness of this problem, in the multivariate sense; we tend to focus on particular areas. And I think this is even true with respect to cognition.

Some (cognitive training) programs focus on what's called speed of processing, which is probably much more than that when you look at the specifics of the training, but there are many other aspects of sensory function, whether it's vision or hearing, motor function, and cognition in terms of visual spatial memory, executive control, as well as perception and speed of processing that may be important.

In addition to the randomized control trials, which really are the gold standard, we need more observational studies. Think of it as epidemiology for driving, in which we track different driver populations based on the choices they make in life, to give us hints as to what randomized control trials we might perform in the future. And again, there are precious few observational studies that would provide information and hints as to what kinds of training interventions we might pursue.

Stratified sampling is very important and many of the studies that have been done have focused on individuals that are older and individuals that have very specific problems, whether it's in vision or visual attention or what have you. So we really don't know, if we look at these studies, how these training interventions apply to the broader community of older and middle-aged.

Accidents are certainly the bottom line in terms of the outcome variables, but it takes a large study to get enough accidents to make much sense of the data.

Studies that combine both the instructional/classroom training, with some on-the-road or simulator training tend to fare better in terms of the outcome variables. So if we're looking for programs that

might be useful for older adults, knowledge is important, but so too is feedback and actual practice with someone experienced to provide that feedback.

Elin Schold Davis, OTR/L, American Occupational Therapy Association

Occupational therapy addresses activities of daily living which are really core to people's functioning, their abilities to do the things that they want to do. When we look at driving, occupational therapists look at driving as an instrumental activity of daily living; we look at driving concerns as an issue of function, not an issue of age.

Occupational therapists, in their evaluation process in the rehabilitation setting or in the hospital setting, will look at this minimum skill set in the domains of vision, physical ability and cognition. Then we want to think about, would those impairments challenge one's role as a driver? Would those impairments challenge their critical roles of transporting other people, driving grandchildren? We find seniors equally as concerned, making sure that they're safe to do these roles.

Not everybody needs a comprehensive driving evaluation, but if it were you being told by the results of a screening tool that you needed to stop driving, would you want the opportunity to have your individual skills and abilities measured so that you have that opportunity to see if there's anything that can be done?

I think driving evaluation is one name for many different services. These have different personnel, different training and different outcomes. At the driver licensing level, you have a performance-based test that's really a pass/fail. At a physician level, you're looking at the medical condition. At a driving school, their mission is to teach people to drive. A comprehensive driving evaluation by an OT is looking at a mixture of the assessments, pulling them together in a comprehensive evaluation. We look at their history. We look at physical assessments, such as how their arthritis might affect their driving. We look at getting in and out of a vehicle and loading their equipment. We look at visual perception. We look at cognition. For a comprehensive driving evaluation, we also add the performance-based, behind-the-wheel assessments so that we can see how these impairments play out in context on the road.

The purposes for our evaluations and our interventions are to see if we can ready somebody to drive. In occupational therapy, if we do an evaluation, it's followed by treatment. When we try to figure out what a person's problem is, our mission is to then figure out what we can do about it. So our goal is to remediate. Whether it's putting hand controls in their vehicle, extending their pedals for driving, making sure they not only have a scooter, but they can get it in their car.

The Association for Driver Rehabilitation Specialists (represents) a multidisciplinary field, including occupational therapists, driving school educators, driving instructors. It also includes rehab engineers and vehicle modifiers. The American Occupational Therapy Association has a certification in driving and community mobility.

Driver rehab dates back to the beginning of the vehicle -- Franklin Roosevelt drove with hand controls. It originated looking at people with disabilities to assist them with driving.

Panel 5 - State Programs and Practices

Jane Stutts, PhD, UNC

I have been working on a project with support from the AAA Foundation and with assistance from AAMVA to develop a database and a website of State policy, programs and practices. It is housed on the AAA Foundation seniordrivers.org website. There are two parts to the database; the first part is LPP -- license, policies and practices. The second part of the database contains noteworthy initiatives (to determine) what initiatives could we possibly promote to other states. So we have about 40 initiatives.

The database covers vision standards for driving; renewal requirements for driving; we have tables on physician reporting, reporting by family members and law enforcement; we have a table on the medical review process, both for states with a medical advisory board in place and those without a medical advisory board; information on referrals; information on restricted licensing practices, along with any particular training that they do for their local examiners and their staff; and information about whether or not they have a website with information for older drivers or medically at-risk drivers and what information is available in their handbook.

Grabowski, et al., looked at state practices to identify licensing renewal practices and driver licensing practices related to safety. That study found that the only renewal requirement or licensing requirement that was related to safety was having in-person renewal for the older drivers, 85 and above.

When we're looking at laws that are put in place in different states and whether or not they're effective, we seem to focus on states that have imposed some additional qualifications or requirements for older drivers. (cited a study that was done by the University of Alabama Birmingham team evaluating the license change in Florida, when they started requiring vision testing, thereby creating a de facto, in-person renewal policy. They did find that there were changes in fatality rates in Florida and compared to the neighboring states, Georgia and Alabama, that didn't have those changes in those age groups that were affected. Another panelists noted that 20 percent of Florida drivers age 80 years or older did not renew.)

We've seen a lot in the States over the past decade or so, as their resources have been tightened up, instead of passing stricter requirements on older drivers, particularly in terms of length of renewal cycles or frequency of renewal, they will extend it for the middle age group. They will leave it for the young drivers and then extend it for the middle age group and not change it for the older age group. That's easier for them to do because they're not up against a lot of fight by people who don't want to put a new requirement specifically on older drivers, but it has the same effect, essentially.

Graduated de-licensing, a phrase I think that Pat Waller introduced back in the 1980s, is not in practice, but some states are offering local or tailored drive tests, and this is something that Iowa, Kansas and I think, Minnesota, offer.

Loren Staplin, PhD, TransAnalytics

With regard to functional fitness to drive, we recognize the public health mandate that licensing authorities are charged with carrying out. Our society accepts driver qualifications, broadly speaking, and I'm sure most would agree with the aphorism that we all need to see to drive. So we accept vision testing when we enter licensing and in some states, that renewal. We accept more stringent qualifications requirements for commercial drivers, even more stringent for those carrying hazardous materials.

Over the past decade or so, there has accumulated a respectable body of evidence using large population-based samples, representative samples that have been tracked over a period of years permitting prospective analyses of these relationships between function and crashes.

We do have a pretty respectable body (of research), in fact, to have allowed us to take some of these relationships and build them into programs that are being implemented in licensing jurisdictions, either on an ongoing or a pilot basis. I'm thinking in particular of Maryland and California.

Licensing agency customers go through the normal process. A few, in this case by age, are diverted into a brief screen focused on cognitive measures. Most, the very vast majority, pass. A few are tagged for further evaluation by a medical advisory board. Over time, there is a continual process to improve the ability to set cut points so that you have the sensitivity and specificity that you want and which are compatible with the agency's resource allocations. It takes time, obviously, to do this and you want to make sure that the money you're spending is targeted at that segment of the population where you're most likely to pick up those with age related functional deficits.

I want to stress also, that this whole issue of screening for functional fitness to drive is a very important crosscutting issue. We heard yesterday from people who were responsible for developing the next version of the highway design handbook and for people who are involved in vehicle design improvements targeted towards older persons' safety. These human-centered design initiatives need to have some kind of benchmarks.

When a brief cognitive screen is to be adopted, there does definitely need to be some federal regulation with respect to methodology and criteria so that the process is standardized across jurisdictions. The opportunity to do that is, of course, when it's first implemented.

Right now, we don't do functional screening. If we want to have a program, not just by 2025, but in, let's say five to ten years, now we need to have an ambitious research agenda that, in one or more States, for at least a limited period of time, obtains this kind of screening data for a large number of people and

follows them so you do have the power to do that analyses and identify the tools that are going to be the most appropriate in this regard.

One thing you could say to a legislature who poses that question (at what age to begin screening or shorter renewal periods), you could show them data that would support the notion that if, for whatever reason, you would like to screening at the age of 25, you'll need to spend \$10,000 to find one person who might have an issue with impairment. If you would like to spend only \$75, then you can start screening at age 90. I mean, there's a definite relationship there.

Carl Soderstrom, MD, Maryland DOT

(The state of Maryland's) Medical Advisory Board, we think, is the oldest in the world. It was founded in 1947, two after that came in Florida and Delaware. Now there are many Medical Advisory Boards. About two-thirds of states have them, but they function in very different degrees throughout the States.

Members of our board get appointed by state law by the administrator of the MVA to give an advisory opinion for cases of any licensee or applicant for license, if the administration has good cause to believe that driving a vehicle by him or her would be contrary to public safety.

We need to improve efficiencies about what conditions are reportable (to MABs). As science comes in, we have to think about, what are the conditions that really, really count. For instance, anyone who had diabetes in the past was supposed refer themselves to the MAB, well, the higher risk is obviously in insulin-requiring diabetics, so let's take that route and drop out the oral diabetics. If I have a brain injury and I recover from that brain injury to a certain level of recovery with OT, that case should be closed. You need to be able to close cases.

With regard fostering broader clinical engagement in older driver safety by encouraging better patient assessment and reporting, one of the recommendations that came out of the 2003 (NTSB) forum was that part of the curriculum in medical schools should be that this subject. As far as I know, it still hasn't been accomplished.

The way that people come to us -- the paths to the MVA -- can be through court referrals. They can be requests for reexaminations from policemen who encounter a driver and have a concern about their fitness to drive; the self-reported conditions at the time of application or renewal; a report from clinicians; or, concerned citizen letters. I will say that a letter that says I'm concerned about the driving of my ex-husband is very different from the, I'm concerning about the driving of our father who's had a couple fender benders in the last couple months and we're concerned about him; and then we also get referrals from customer service agents.

Basically our philosophy is safe mobility for life. We want people to drive as long as they are safe and consider each driver on a case-by-case basis. We accomplished this with medical assessments, reeducation, rehabilitation, and training programs.

IIHS's summary of State driver licensing laws identified 18 States that shorten the time between (license) renewals for older drivers. The States vary in age from when that accelerated renewal starts, ranging from between 61 and 85, kind of a broad range there. How do we discern what an appropriate age is for when we need to begin taking greater look at older drivers? I think we could work our way backwards and possibly say that people 110 years of age probably need to be assessed and then start working your way backwards. But the question is, I think, what is old, what is senior, what is elderly, and I don't think we have the answer to that question right now. The panels yesterday and today make it very clear that one 85 is not equal to another 85.

Essie Wagner, NHTSA

NHTSA takes a sort of a comprehensive approach to addressing older driver safety. The way that we go about it is we try to find the people who have a way to identify the at-risk driver. We have the families and friends and the older drivers and the general public who have some way of seeing that something's not right that's going on. But we also have professional organizations and professional individuals who have the ability to recognize somebody, and there are driver licensing, healthcare professionals. Social services are very important as well; for example, area agencies on aging. We also include, for example, the Alzheimer's Association and people who can do some educational activities, as well as law enforcement.

We developed the NHTSA driver fitness medical guidelines in partnership with AAMVA . These are voluntary guidelines for assessing drivers. We want driver licensing to be talking with law enforcement and we want law enforcement to be making those referrals to the DMV. But we also want law enforcement to be talking to social services saying, well, if this individual is found driving at, you know, 2:00 a.m., driving erratically and they're not otherwise impaired, we want them to be taken care of appropriately.

I would like to have functioning Medical Advisory Boards in every state; I want them to adopt the (NHTSA federal) guidelines and to actually make sure that they are screening and identifying the people who are at risk on their roads.

In terms of the older pedestrian fatalities, older people represent 18 percent of the pedestrian fatalities, but are only 13, 14 percent of the population. So they are definitely over-represented. Most of those fatalities are happening in urban, suburban areas and they're much more likely to be intersection-related crashes.

Chairman Debbie A. P. Hersman, Chairman, NTSB

The discussions we've had over the past two days remind me of the aphorism, "A rising tide lifts all boats." First coined by Sean Lemass, an Irish politician, and later quoted by President Kennedy, this phrase aptly describes so much of what we've discussed. The older driver is certainly a "rising tide" as

people live longer and continue to drive well into their older years. Whether it's introducing inflatable seatbelts to make an accident more survivable, providing the driver with a heads up display of the exact information they need, making roadway signs easier to read, or creating new tools to assess a driver's fitness, the safety improvements we make for some, improve highway safety for us all.

We've made great strides in safety since the first driver's license was issued in the United States a century ago. Hopefully, through the sharing of best practices and experiences, and with the active participation of the licensing agencies, physicians and our communities, we can reach responsible and informed decisions on how to make our roadways safe for us all - and to do so in a way that balances individual independence, mobility needs, and safety. These goals are not mutually exclusive in our society. Collectively, we have the opportunity, as well as the obligation, to address them concurrently and with some urgency.